AGRICULTURAL Research

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CONTENTS

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More system

Systematic examination of facts is the heart of scientific research. Is there also room for *more system in bringing agricultural problems under study?*

This issue of AGRICULTURAL RESEARCH reports a notable example of *cooperative programming* in pasture research for the Northeast ("Making Orchardgrass Companionable," p. 6).

Agreement was reached in joint planning conferences of ARS and the region's 12 State experiment stations. Much of the basic research is done by ARS, and applications (especially local relationships) are worked out by the States. Definite projects are earmarked, with scientists and institutions doing work they're specially qualified to do.

Joint State-Federal technical committees are set up to advise and check on important work areas. Such a committee is now evaluating new orchardgrass selections developed at the Regional Pasture Research Laboratory and will advise what to do with various strains. Through these committees and through progress reports at annual planning meetings, the region's researchers keep fully abreast of this work.

It's the general concensus that progress toward better pastures is years ahead of what might have reasonably been expected had the work not been integrated.

Perhaps other research areas could profit by closer cooperation—*more system*—in programing and conducting studies.

This country's agricultural research is the work of many institutions—private, State, and Federal. By considering more problems collectively and agreeing on what needs to be done and who shall do it, we may find that we can get more results for our money—and also get them sooner.

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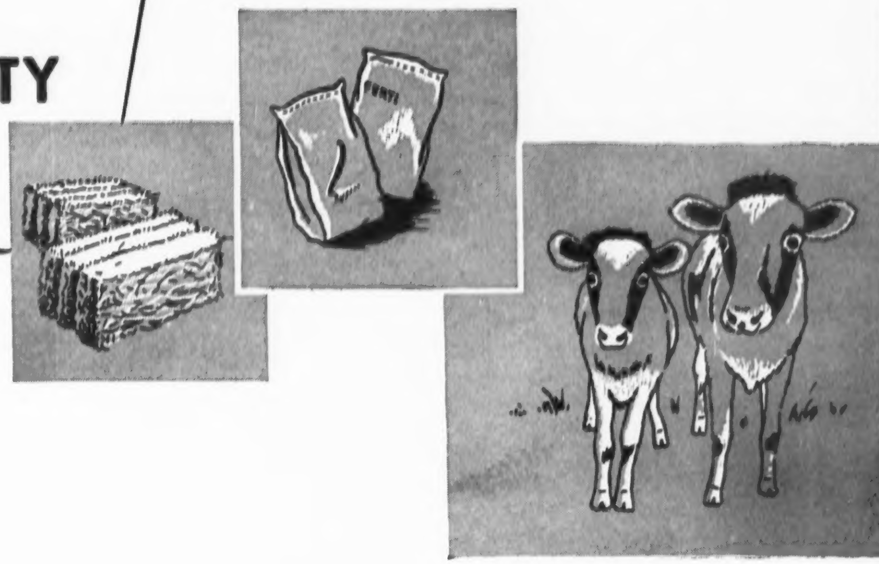
AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

OUR FOOD-QUALITY FRONTIER



Scientists are pushing into a dark region—nutritional relationships of climates, soils, plants, and animals

IN his quest for more food, man will have to think not only of high yields but also of soil management that returns *nutritionally richer crops.*

That's the conclusion of Director K. C. Beeson and his staff at USDA's Plant, Soil, and Nutrition Laboratory, Ithaca, N. Y., after 15 years of studying the basic nutritional relationships among animals, plants, soils, and climates. Though research has shed a little light, we're still in the dark ages on these matters.

Here are some significant facts:

Test animals grow differently on seemingly identical turnipgreens from soils in two Georgia locations.

Lambs grow poorly on soybean hay from low-phosphorus soils but respond to a phosphorus supplement.

Calves develop a goiter-like growth and won't gain on over-fertilized timothy hay in New Hampshire.

TURNIPGREENS grown at Ithaca in pots of soil from two parts of Georgia differed greatly in growth effect on test rats. Greens from one area had much vitamin B_{12}. Climate was studied (see instruments) as possible factor, but soil makes the real difference.

Cattle are unthrifty on forage from low-cobalt soils in North Carolina but thrive if fed mineral cobalt.

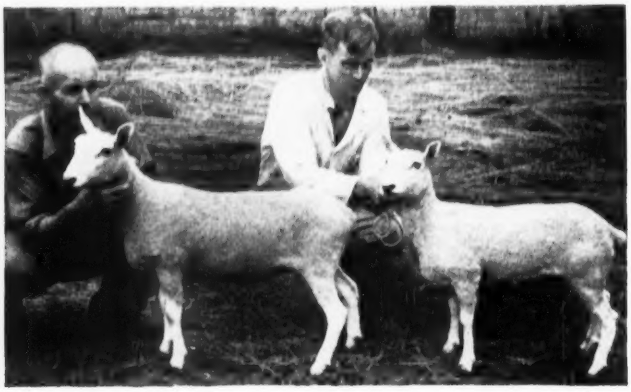
A few studies show the variety of factors that can affect the quality of food and feed plants. For example, the laboratory found some years ago that the amount of vitamin C in tomatoes depends on where they're grown. Soil differences were considered, but intensity of sunlight at ripening stage proved the principal cause.

Potatoes also differ widely in vitamin C, but the laboratory found that this is a genetic difference. ARS is now breeding high-vitamin-C varieties.

Then there is the soil factor. For several years the experiment stations of Georgia, North Carolina, Mississippi, Oklahoma, Texas, and Puerto Rico have been cooperatively studying quality variation in turnipgreens. They're important in many southern diets, and especially so to provide vitamin C for families using little milk or citrus fruit. The Ithaca laboratory joined in the study, using laboratory animals as a yardstick.

ARS nutritionist Louise Gray and associates, working in cooperation with the Georgia station, found that rats grow much better on turnipgreens from Blairsville, Ga., than on turnipgreens from Experiment, Ga., in another part of the State. Vitamin C didn't vary much—but the better greens contained a vitamin-B_{12}-like substance of which the poorer greens had little or none.

That's the first discovery of this nutrient or its precursor in plants. Its presence was proven with an organism that requires vitamin B_{12}, *Ochromonos leichmonii.* This grew on the better greens—also on the livers of B_{12}-



SAME SIZE ONCE, these lambs were fed hay grown on low-cobalt soil. Lamb at left also got cobalt in diet. Better growth and condition from eating cobalt is the only diagnosis for cobalt hunger.

starved chicks fed exclusively on the better greens. But the organism wouldn't grow on the poor greens.

Adding major and minor mineral nutrients to the Experiment, Ga., diet didn't help, but adding B_{12} restored full growth. We need to learn how to make plants a dependable source of this vitamin. Since bacteria build B_{12}, the researchers are looking to soil microflora, soil organic matter, and soil minerals—especially cobalt, a constituent of B_{12}—for an explanation. Soils in the area around Experiment, Ga., are deficient in cobalt.

Earlier ARS–North Carolina station research has shown that sheep and cattle are unthrifty when dependent on forage from a low-cobalt soil. This can be corrected by adding a trace of cobalt sulfate to soil or diet.

Another problem is the matter of toxic feeds. E. J. Thacker, G. H. Ellis, L. J. Daniel, G. D. Duncan, and Miss Gray have traced so-called zinc and molybdenum poisoning from retarded metabolism in animals back to mineral excesses in the soil on which their feed grew.

Excessive zinc in crop soils harms animal consumers of the crops in two ways. For one thing, extra zinc gets into the crop at the expense of copper, since the two minerals compete to nourish the plant (AGR. RES., Dec. 1954, p. 6). Rats on a copper-deficient diet couldn't make enough of two important copper-bearing enzymes, ascorbic acid oxydase (forerunner to vitamin C) and tyrosinase (a tool in body use of inhaled oxygen). In the second place, excess zinc in the diet causes anemia—interferes directly with the rats' manufacture of another important enzyme, cytochrome oxydase, which helps use copper to make hemoglobin (red substance of the blood).

Poisoning from feeds grown on high-molybdenum soil, on the other hand, is an obstruction to body use of the important amino acid methionine. Such a diet stunted rats, but not when methionine was fed too. A copper supplement also mysteriously helped some, but only when the methionine wasn't supplied as an antidote.

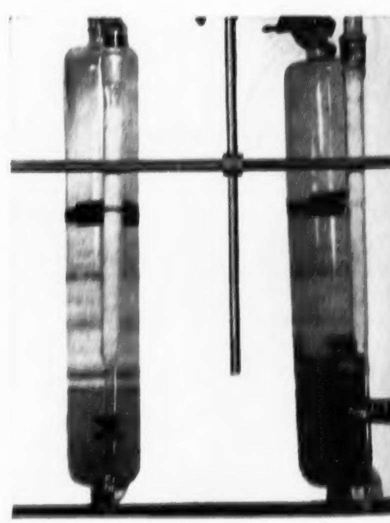
Plants need a trace of molybdenum—also manganese—but too much of either poisons livestock. At Ithaca, J. F. Thompson found that plants use molybdenum to reduce nitrates, as generally believed, but contrary to opinion, don't necessarily use manganese that way. He wants to know how a plant uses these and other elements—whether for making chlorophyll or any amino acids.

So the study of amino acids in plants might reveal what the plant does with its soil-derived minerals.

Thompson found the amount of a mineral in the soil has little relation to the amount of amino acids formed in proteins in the plant, but a close relation to buildup of specific *non-protein* amino acids. This may lead to a new soil test by paper chromatography that simply, quickly, and inexpensively shows amino-acid content of plants growing on the soil. Any deficient ones might point to the mineral lacking in plant and soil.

PAPER CHROMATOGRAPH (left), ingenious analytical tool, was made by putting extract of turnipgreens on upper right of filter paper. Solvent from above washed the greens' amino acids down and deposited them in a vertical line. Then, with right side up, a second solvent washed them various distances—to left in above position. Distance of each spot from starting point (and other factors) show which amino acid it is. Density shows how abundant it is. Abnormal amino-acid content in plant might pinpoint a specific mineral abnormality in the soil.

POND-SCUM PLANT chlorella (right) is similar to higher plants in its use of nutrients to make amino acids. Chlorella in jar at right grew better owing to greater quantity of iron in the nutrient solution.



How does the mineral selenium cause stock poisoning? Thompson found that plants tend to use it in place of its chemical relative, sulfur, in making methionine. That, in turn, is used in making an essential amino acid, cysteine. Without sulfur, plants make a cysteine-like amino acid that doesn't satisfy an animal's sulfur need. So selenium poisons by causing sulfur hunger.

In this work, Clayton Morris and Thompson discovered an unknown amino acid—methyl cysteine sulfoxide—in turnipgreens. Quite similar to methionine, it also contains sulfur. To find whether animals can use the new compound instead of methionine in making cysteine, he'll apply it to liver (the organ that builds cysteine) and culture the liver with the cysteine-dependent bacterium *Leuconostoc mesenteroides*. Bacterial growth would prove that cysteine had been produced. Thompson will also check the new amino acid as a possible antidote for molybdenum "poisoning"—in other words, as a means of getting around the faulty methionine-cysteine dependency.

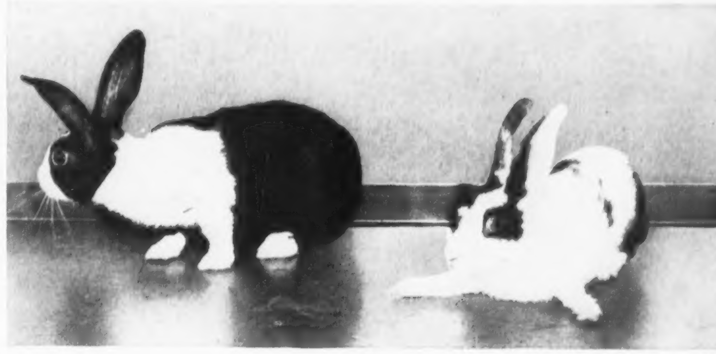
Not all animal nutrition diseases are linked to trace minerals (those occurring at less than 20 pounds per acre-foot of soil). Take phosphorus. G. Matrone, formerly with the laboratory, worked on phosphorus with the New York (Cornell) and North Carolina stations. He found low-phosphorus soils yield nutritionally inferior legumes. Lambs gained little or none on hays from such soils—only a half to two-thirds as much on soybean hay from the latter State. Rabbits fed such hay developed weak bones. Phosphorus supplement solved the problem, especially when supplied through soil and crop.

Curious as to the best rate for fertilization, dairy husbandman H. A. Keener, of the New Hampshire station, fertilized a timothy crop near Durham very heavily and fed the hay to 3-month-old calves. The calves formed a goiter-like enlargement of the thyroid and failed to gain normally until other hay was substituted. Thacker got similar results with rabbits fed this hay. Even supplementing with the known mineral constituents of alfalfa, or alfalfa ash with the inferior timothy, brought about normal growth. Why? Thacker thinks phosphorus in the timothy planting may be a factor—doubts that current tests will show any connection with iodine.

It has been suggested that adding organic matter to low-humus soils improves nutritional quality of crops. C. S. Brandt and Beeson found that has little effect.

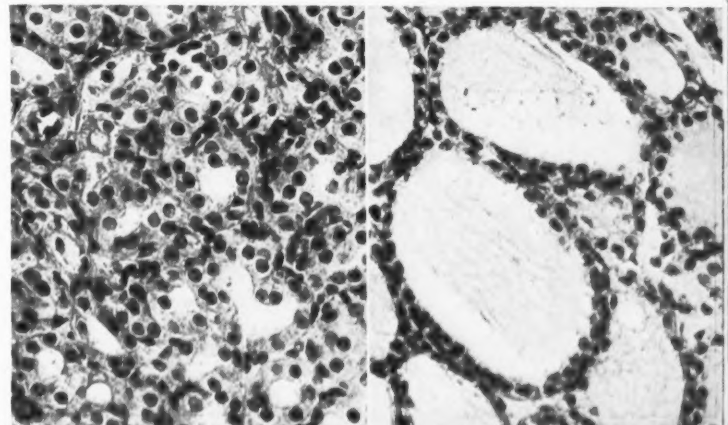
Now that we're beginning to understand some basic nutritional principles better, it's only a matter of time until scientists turn these discoveries to farm use.

While pressing the search for even more basic knowledge of the soil-plant-animal nutrient relationships, our scientists have started mapping our minerally abnormal soils. We'll tell that story next month.☆



LITTERMATES were fed soybean hay from a low-phosphorus soil. Rabbit on left got added phosphorus, grew well, and formed strong bones. One on right grew poorly and had weak bones. One leg broke.

HEAVILY-FERTILIZED timothy hay stunted calf at left. Other calf, same size at start, grew well on normal hay. Rabbits also were stunted and goiterous on timothy (see thyroid tissue in photomicrograph at left), and normal on regular hay (thyroid tissue at right).



crops and soils

MAKING ORCHARDGRASS COMPANIONABLE

We want it nutritious, disease-resistant, and late maturing

STEMMY, disease-prone, early-maturing orchardgrass is being remade by USDA researchers into a better forage partner for the East.

ARS plant breeder H. L. Carnahan and pathologist J. H. Graham have several promising strains of orchardgrass of widely varying characteristics growing in test plots at the U. S. Regional Pasture Research Laboratory, State College, Pa. They were selected from orchardgrasses growing there—some of local origin, some collected by other scientists, and some introduced from abroad.

The collection includes some late-maturing strains—a major objective. We need an orchardgrass that's more companionable with alfalfa. Orchardgrass in the mixture would extend the season and maintain a more even stand throughout the grazing season. Alfalfa would improve the nutritional quality of the forage over orchardgrass alone. But present commercial orchardgrass goes to seed early. Cutting such a mixture at the right time for the grass may injure alfalfa and cause it to die out.

Like USDA's recently developed Potomac variety of orchardgrass, most of the experimental lines resist rust, a serious disease. Unlike Potomac, several of the new strains also resist purple leafspot and the leaf streak or brown stripe disease, but one otherwise-desirable strain is susceptible to leaf streak.

Early growth of standard orchardgrass is coarse and stemmy—short on leaves, the more nutritious and palatable part of the plant. Two or three new strains form large, vigorous stools of fine-stemmed vegetation well-leafed up the stem. All recover quickly from cutting and make good growth throughout the season.

A forage-crops joint committee of northeastern experiment stations and the Pasture Laboratory is evaluating the performance of these clones and soon will decide whether any has enough all-round superiority. If so, they will be increased either by seed or vegetatively by tiller division to supply all 12 northeastern experiment stations for testing in their varied climates. It's hoped to extend the range of adaptation on this important humid-area grass all the way to the Canadian Border.

It'll take a year or two for the increase, about 3 years for testing, and several years to build seed stocks of clones that may be chosen as a new variety for farm planting.

Whether any present strain is increased as such, three or more of the best will be mixed in an isolated planting at the Pasture Laboratory and allowed to cross-pollinate. Wind does the crossing. This polycross method makes many genetic combinations, which in turn will be screened for still better clones.☆

STANDARD *orchardgrass is susceptible to common leafspot, shown here, and other diseases. Disease weakens plants and destroys leaf tissue, most nutritious part of plant.*

SEVERAL NEW STRAINS *of orchardgrass, grown in plot at Pasture Laboratory, resist disease and vary widely vegetatively. Each row of plants is a pure strain increased by tiller separation from a single plant originally chosen for its outstanding traits. Note the difference in productivity, fineness of stem, and proportion of the plant in valuable leaves.*

Ridge Farming: PROBLEM SOLVER

THIS PROMISING PRACTICE HOLDS WATER AND SOIL—AND SAVES WORK

FARMING on contoured or graded ridges—much as tobacco and cotton are grown in the Southeast—may prove just the practice for many areas to conserve soil, water, labor, and machinery in growing corn.

Standard Corn-Belt row-cropping leaves the land vulnerable to erosion, to rapid runoff of water before the soil can absorb it. And rapid runoff may also create drainage problems in some parts of the fields. There's a great need for prompt, orderly removal of water from the principal root zone—but retention of the water close by for a while to give the crop a second opportunity to make use of it.

A preliminary look at a 4-year cooperative experiment by USDA and Iowa experiment station engineers at several locations in Iowa suggests that contoured ridges may be the answer. Though different principles are involved in erosion and flooding, ridge farming helps solve both.

By turning up a high bed (ridge) with a moldboard plow for the corn row, experimenters W. F. Buchele and W. G. Lovely, of ARS, and E. V. Collins, of the Iowa Station, created a hospitable root zone for corn. The root zone was drained of excess moisture, yet had an above-ground storage capacity of about 2 inches of water. That will hold a high percentage of rainfalls that don't filter through the soil—without waterlogging the bed.

When a field is drained of surplus water, the ridge dries rapidly at the surface. Moisture content increases with depth, reaching its maximum concentration at the 7-inch depth. In contrast, soil under the furrow of a listed field remains wet near the surface and attains its maximum moisture at 4 inches depth. In the Iowa tests, water drained from the ridge into the furrows and was slowly channeled from the field. Yet, because the furrows and ridges followed the contour, both runoff and soil erosion were retarded. Therefore, more water remained "banked" for future withdrawal by the crop.

Because of better drainage, the raised bed was 1 to 8 degrees warmer at the 3-inch depth than at the same depth under a lister furrow and slightly warmer than at the 3-inch depth in the normal level surface.

Where starter fertilizer was applied to the plots, the ridge retained nitrogen much better at the 3-inch to 6-inch depths—especially the former—than did the soil under the lister furrow. The experimenters think better nitrification of organic residues by bacteria, due to greater warmth, may be an important cause of this. They also point out that soluble nutrients in the lister furrow are more likely to be dissolved and carried off of the field in the runoff water.

Now that ridge farming has shown promise, the Iowa experiments are being broadened and extended into a more complete study of 10 tillage variables as involved in this new system. Such factors as soil microbial life, tillage methods, nutrient application and uptake, and weed-control methods and equipment are under study in far greater detail on both the ridged plots and flat plots. Thus researchers hope to learn just what is affecting yield.

When fuller evidence is in, a year or so from now, Corn-Belt problem farms may have a brighter future.☆

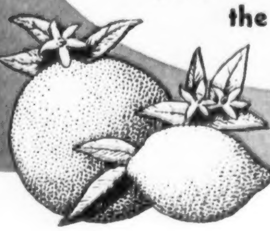
RIDGING a field on the contour with a two-way, modified-moldboard plow makes the preparation of a seedbed a quick operation.

FURROWS form a reservoir, permitting a good soak-in, rather than the usual rapid runoff that washes soil and wastes water.

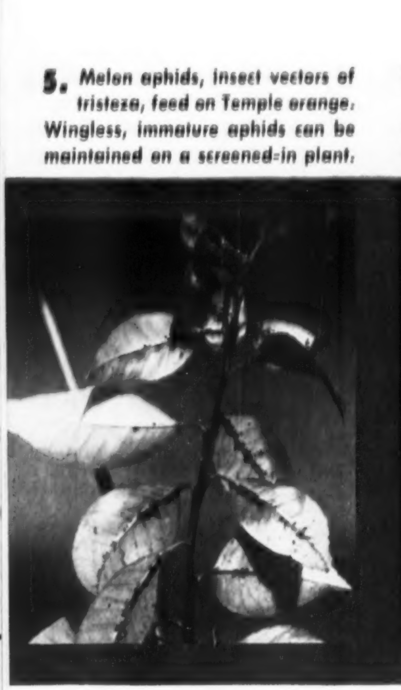
RIDGED FIELD looks like this at end of season. Water conservation and effective weed control made this good yield possible.

TRACKING DOWN TRISTEZA

Research is making progress in the citrus-virus fight

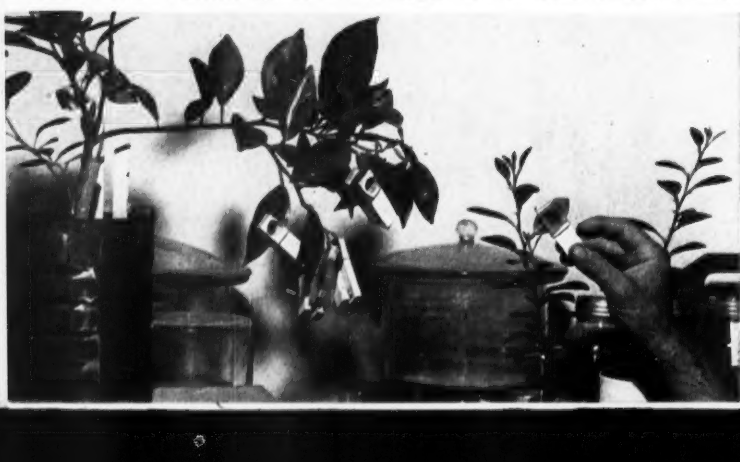


1. Tristeza infection (maybe along with other virus diseases) has r destroyed this Temple orange tree growing on sour-orange roots. Healthy Temple trees in background are undoubtedly infected with but are growing on tolerant rootstock. Pathologist T. J. Grant, found tristeza for the first time in Florida in this grove near W Garden, says visible symptoms have been apparent on this tree 3 y



5. Melon aphids, insect vectors of tristeza, feed on Temple orange. Wingless, immature aphids can be maintained on a screened-in plant.

7. An additional identifiable symptom of tristeza that plant pathologists have been able to find on Key lime is stem-pitting under the bark.



6. Winged aphids are caged on the leaves of citrus plants to prevent insects from escaping and thus assure contact with the plant. Here, entomologist Paul Norman transfers aphids in their cages from diseased to healthy citrus.

THE tristeza scare that gripped Florida's citrus industr a few years back has dissipated, but the threat of th disease is still to be reckoned with.

Tristeza was identified in Florida in 1952. This wa the same virus disease that had destroyed millions of citru trees in Argentina and Brazil just a few years before Growers had visions of impending disaster—at best, a rigorous quarantine and eradication program.

Additional knowledge of the disease, gained throug recent research, has allayed some of these fears.

ARS plant pathologist T. J. Grant, at USDA's Horticultural Field Station, Orlando, first identified the disease in Florida. He cites these research facts:

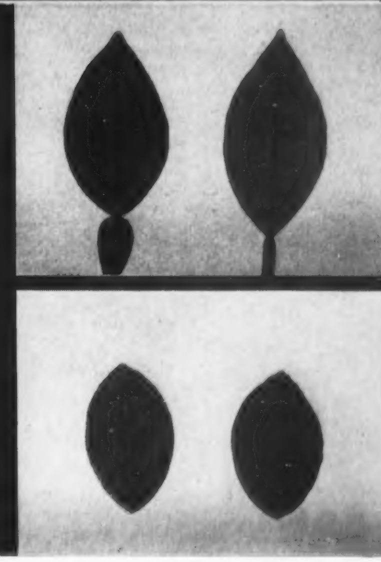
The disease is widespread in the United States. (Th so-called quick-decline disease of citrus reported in California in 1939 has proved to be a strain of the tristeza virus.) It occurs in citrus areas of Florida, California Louisiana, and Texas. Scientists suspect that it arrive here at least 20 years ago from the Orient.

The prevalent strain complex of tristeza virus in thi country is relatively mild in its effect on tree health a compared to the severe strain complex that decimate Brazil's groves. Pathologists now believe that citrus tree infected with mild strain complex may have some protection from infection by the severe strain.

At least two aphid species—the green citrus aphid an the cotton or melon aphid—can transmit the tristeza viru from tree to tree. But neither is a particularly efficie carrier of the disease. Brazil's very efficient vector, th Oriental brown citrus aphid, is not known to occur in th

2. Most stunted Key lime plant (4) is infected wtih both tristeza and psorosis viruses. Compare with a healthy lime (1), a psorosis-infected plant (2), and one infected with tristeza (3). Scientists are attempting to find out if infection with two diseases causes only an additive effect, or whether one disease actually complements another.

3. Simple leaf-graft technique provides quick, easy way to transmit virus infection to a healthy plant. Here, stem of Key lime seedling is slit; leaf piece from infected plant is fitted into slit, taped in place.



4. Key lime remains only reliable indicator plant for tristeza; below, note vein-clearing symptoms on infected leaf. Sweet orange plant shows distinctive psorosis symptoms; above, note veinlet banding on infected leaf.

United States. The virus can also be spread by grafting infected wood onto healthy trees.

Trees grown on sweet orange or rough lemon rootstock are tolerant to the virus; trees on sour orange—in Florida, about 30 percent of all citrus—are susceptible.

Such information has reassured growers who feared disaster, but there's still a serious possibility that this disease could become an important citrus destroyer.

As Grant explains: In an average infected Florida orange grove, the disease now appears to spread at the rate of about 5 to 7 trees a year. Under these conditions, a grower could rather easily replace declining trees with new trees on tristeza-tolerant rootstocks. But the use of tolerant rootstocks does not slow the spread of the virus. In time, infected trees will become so widely established as to present a constant threat to all susceptible trees. And there is always the chance that an efficient vector such as the Oriental brown citrus aphid will slip in past the quarantine barriers on our borders. We must, of course, prepare for such eventualities.

Developing methods of preventing or controlling tristeza, other than replanting on tolerant rootstocks, is proving difficult. Like most viruses, tristeza can't be readily identified and is even less readily isolated. The presence of several tristeza virus strains or mixtures with other viruses makes the job even tougher.

Grant, who studied the disease in Brazil and Florida, says that at present there is no rapid way of positively identifying tristeza by examining an orchard. Twigs or leaves from infected trees must be budded on lime plants of the Key variety to get identifiable symptoms. (Key limes were used to positively identify the disease in Florida, and later in Texas. They are used by plant introduction stations to prevent the entry into this country of apparently healthy but tristeza-infected citrus.)

Attempts to free infected budwood of psorosis (another citrus virus) and tristeza by hot-water treatment ended in failure. Exposure at 55° C. for even 10 minutes destroyed nearly all buds, and the tristeza and psorosis viruses survived in tissue that remained alive.

Tristeza in Florida appears in many cases to occur in combination with other virus diseases such as psorosis and Orlandon tangelo disease. This raises some questions: On which disease can the unprosperous condition of the tree be blamed? Do these or other unidentified viruses affect the tree independently or do they complement one another? If the latter is true, does the order of infection determine the final disease effect on the tree?

Faced with such questions, Grant and associates first attempted to study tristeza by growing trees infected only with an insect-transmitted source of tristeza.

Now the scientists are infecting citrus with several of the viruses and studying plant reactions. Methods so far developed take only a few weeks to produce symptoms of two different viruses—psorosis and tristeza.

Grant says that this symptom-research will eventually provide them with valuable information about several other citrus viruses—information that will serve as a basis for control. As with most virus disease studies, he says, it's best to let the plants do the talking.☆

livestock

FREEZE-DRIED POTATOES

They make a practical stock feed, and we've learned how to get best results

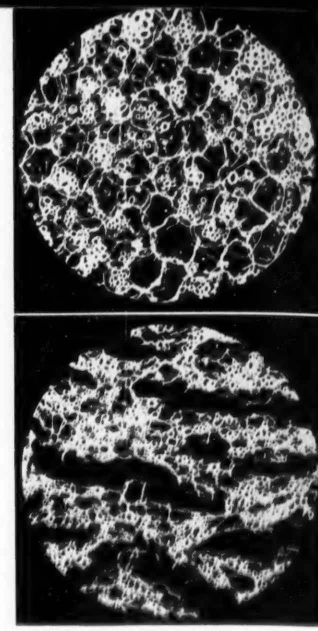
AN age-old method of preserving potatoes—natural freeze drying—makes an up-to-date livestock feed for northern areas. It can also extend the potato-feeding season into late spring or early summer and provide an outlet for cull potatoes.

Farm practice had shown that the process results in a practical, stable feed, but more information was needed. So USDA's Eastern Regional Research Laboratory, in cooperation with the Maine experiment station, initiated a series of trials at Presque Isle, Maine. Data were obtained on the nutrient loss, the mechanism of freeze drying, and on the optimum method of exposing the potatoes to cold weather.

Very little starch—about 8 percent—is lost in the liberated juice because the potato cells are not ruptured. However, about 97 percent of the sugars is lost, 84 percent of the nitrogen compounds, and 34 percent of the crude fiber. No determinations of pectin, organic acids, fat and minor constituents were made.

Potatoes on open racks lost 30 to 40 percent of their toal solids—mostly nonstarch substances. Laboratory tests in alternate freezing and thawing resulted in a loss of only about 10 percent total solids, probably because of reduced fermentation that occurred under laboratory conditions.

For an explanation of the juice leakage and of low starch loss in the presence of high losses of other nutrients, the scientists turned to microscopical examination. This showed that the freezing process causes potato tissue to expand and groups of cells to shear apart from other groups.



STARCH CELLS of potato (top) shear apart in groups (bottom) as freezing causes tissue to expand. Juice escapes through the canals.

After thawing, juice passes through the now-permeable cell membranes and escapes through a network of canals between the separated cells. The greatest loss of juice (23 percent of original weight of potatoes in a laboratory experiment) occurred during the first thaw. Juice loss decreased during subsequent cycles.

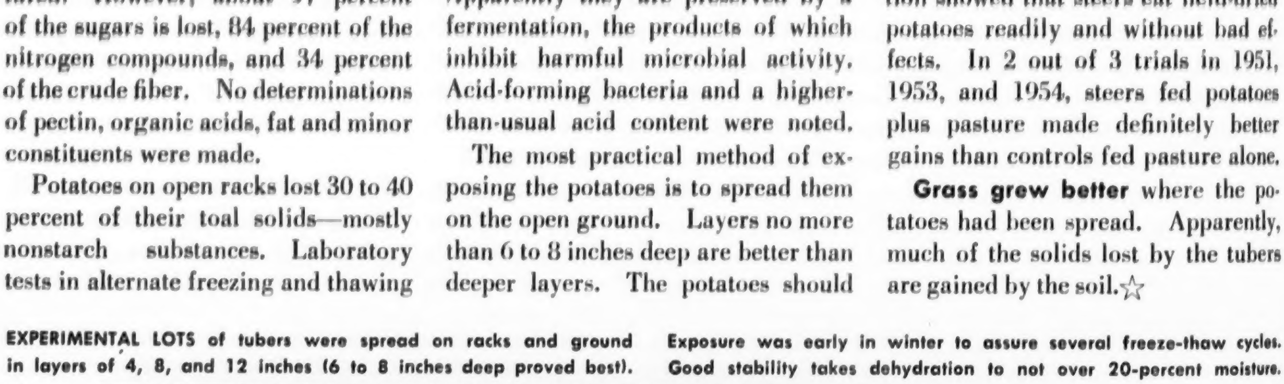
Freeze-dried tubers show no decay. Apparently they are preserved by a fermentation, the products of which inhibit harmful microbial activity. Acid-forming bacteria and a higher-than-usual acid content were noted.

The most practical method of exposing the potatoes is to spread them on the open ground. Layers no more than 6 to 8 inches deep are better than deeper layers. The potatoes should be spread on the ground early enough in the winter to assure exposure to severe freezes. Experience has been that it is most feasible to have the animals eat these field-dried potatoes directly from the ground.

Demonstrations on private farms as well as controlled tests at Minnesota's Northwest School and Experiment Station showed that steers eat field-dried potatoes readily and without bad effects. In 2 out of 3 trials in 1951, 1953, and 1954, steers fed potatoes plus pasture made definitely better gains than controls fed pasture alone.

Grass grew better where the potatoes had been spread. Apparently, much of the solids lost by the tubers are gained by the soil.☆

EXPERIMENTAL LOTS of tubers were spread on racks and ground in layers of 4, 8, and 12 inches (6 to 8 inches deep proved best). Exposure was early in winter to assure several freeze-thaw cycles. Good stability takes dehydration to not over 20-percent moisture.



Researchers try again to raise hogs free of atrophic rhinitis

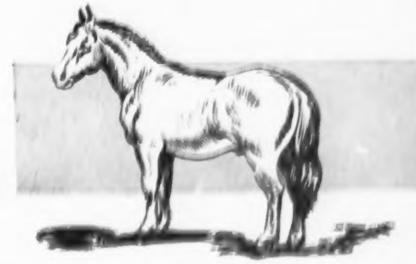
USDA RESEARCHERS have tried two methods of developing an atrophic-rhinitis-free herd of hogs:

1. By raising pigs aseptically (AGR. RES., March 1954, p. 16).

2. By selection with the rhinoscope at weaning time of rhinitis-free litters from sows with the most favorable history in relation to the disease. For this second approach, selected litters were raised in isolation to maturity. Nevertheless, atrophic rhinitis was found in this group of animals.

For a follow-up on a second generation, a number of first-generation pigs were retained for breeding. Despite the negative rhinoscopic examination of a majority of the breeding stock, atrophic rhinitis was still present in the second generation. There was, however, a drop in the incidence of the disease among these pigs.

The rhinoscope was not adequate for detection of all affected animals, and the lower disease incidence appeared to be due to elimination of continuous exposure through isolation and sanitation. This method won't eliminate the disease but does offer a way to hold it down to a minimum.☆



SWAMP FEVER—STILL UNCONQUERED

EQUINE INFECTIOUS ANEMIA—"swamp fever"—is decreasing as horses give ground to motorized vehicles. But this disease is still of grave concern to the thoroughbred industry, establishments that handle many horses, and around the world where horses are still work animals.

Equine infectious anemia is caused by a filterable virus and is essentially a chronic disease although it may occur in an acute or subacute form. Symptoms are intermittent fever, depression, weight loss, edema, congestion and jaundice of the mucous membranes, and anemia.

The disease is spread by biting insects and by contaminated food, needles, or equipment. It can also be transmitted from a mare to its offspring before birth or in the milk.

Big obstacles in diagnosis, study, and control of infectious anemia are lack of a reliable diagnostic test and the fact that the virus does not reproduce itself in another host. The only definite means of diagnosis is transfer of the disease to another horse.

USDA scientists investigated this disease from 1935 to 1954. A large number of horses were experimentally infected. Some cases were held under observation for periods ranging from 5 months to 18½ years and were also used by researchers as a source of active virus for further studies.

Test animals were not worked, got good feed and care, and were kept in isolated stables with concrete floors. Temperatures of all cases were recorded at least twice daily.

Experimental infection was mainly by injection of infected serum.

Results show that horses making an apparent recovery after experimental infection may remain carriers of the virus for 5 months to more than 18 years, with gradually decreasing virulency of the blood. A few carriers recover completely and appear to be resistant to reinfection.

Subclinical cases are inapparent carriers, and their blood can transmit the active form of the disease to susceptible horses. A horse that develops the carrier form may show no active symptoms for years—then die from an acute flare-up.

A reliable diagnostic test would be of great importance for control. However, results of considerable experimental work with the complement-fixation test and others showed them to be unreliable for this disease.

Work on a preventive vaccine—by using inactivated tissue or a virus-free fraction of the virulent plasma—was likewise unsuccessful.

In the search for a specific remedy, USDA scientists tried penicillin, sulfanilamide, formin, merthiolate, arsenical preparations, sodium cacodylate, hydrochloric acid, fuadin, crystal violet, and potassium permanganate. None of these had a specific action against the virus.

For the present, sanitary measures are the best means of controlling infectious anemia. Control of biting insects, use of sterilized needles and instruments, isolation or destruction of infected animals, keeping equipment clean, use of disease-free horses as blood donors, and attention to feed, care, and handling of animals will help. Biological supply houses operating under Federal licenses are required to heat antisera of equine origin—such as anti-anthrax serum—to kill the infectious-anemia virus.☆

Gains that pay

FORAGE CROPS, BYPRODUCTS ARE CHECKED IN MISSISSIPPI BEEF-FEEDING EXPERIMENTS

PROFIT-MAKING methods of feeding beef cattle are being developed at Delta Branch Experiment Station, Miss. The work provides a practicable way to check Federal-State research in forage crops (AGR. RES., September 1955, p. 6), and use of byproducts such as cottonseed hulls, gin trash, and soybean straw.

In charge of the feeding project is animal husbandman E. G. Morrison of the Mississippi station. He buys high-quality steer calves in the fall and winters them experimentally on locally available roughages. The calves graze on annual grass pastures of oats, wheat, or ryegrass until about May 15. Then they shift to perennial pastures of Johnson, Dallis, or Bermuda grass up to August 15 or September 15, when these pastures run out. Drylot feeding begins at this time and continues for 90 to 120 days. Marketing comes in December or January when the steers have put on enough finish for "choice" grade.

The effect of the winter feeding level on the quantity of grain required for subsequent finishing in the fall is closely watched. Researchers want to reduce the grain requirement as much as is consistent with profitable gains and the goal of attaining choice finish within a reasonable time.

Gin trash has proved of little value in wintering cattle unless supplemented by other feeds. Gin trash at the rate of about 13 pounds a day, plus 1.5 pounds of cottonseed meal, 2 pounds of hay, and 0.56 pound of blackstrap molasses, resulted in average daily gains of about two-thirds of a pound. This compares with an average total loss of 5 pounds in 64 days in steers given only gin trash and 1.5 pounds of cottonseed meal daily. Another group of steers fed 14.5 pounds of gin trash and 3.5 pounds of a protein supplement per day gained an average of 0.74 pound daily over the same period of time.

Soybean straw proved a better wintering feed than cottonseed hulls. The cattle used in this experiment were limited to 15 pounds daily of either product, supplemented by 1.5 pounds of cottonseed meal. On the soybean straw plus cottonseed meal, gains averaged 43 pounds in 64 days—on cottonseed hulls plus cottonseed meal, 38 pounds. Figuring hulls at $18 a ton and straw at $10 (baling and storage), the cost of wintering the group fed cottonseed hulls was $12.41 per head, compared with only $8.48 for those fed soybean straw. Researchers point out that use of the straw, which can be baled right behind the harvester-combine, provides a practicable outlet for an available product that ordinarily is wasted.

In another experiment, two groups of steers were fed all the corn silage they would eat. Along with the silage, one group received cottonseed meal and the second was fed Purdue Supplement "A", a commercially available protein feed. In 90 days, the first lot consumed a daily average of 63 pounds of silage and 2.66 pounds of meal per head, and gained an average of 1.61 pounds per head daily. The second lot ate 61 pounds of silage and 3.5 pounds of supplement, with daily gains averaging 1.36 pounds per head for the 90-day period. Feed costs were $18.96 per 100 pounds of gain for the cottonseed-meal ration and $25.34 for the second ration.

Both rations proved satisfactory as wintering feeds, but neither gave satisfactory finish in the 90-day period of dry lot feeding. The cattle in both groups required about 50 days more on grain, or a total of 140 days to come up to the desired choice grade.

A major experiment in finishing beef cattle has been to compare the feed value of oats—often an abundant crop in the Delta—with corn and other grains. Researchers fed oats as the only grain in one experiment, corn alone in another, and mixtures of these grains (some mixtures including barley) in still others.

Researchers found that oats would produce choice beef. But less feed was consumed as the oat content of the ration increased, resulting in lower daily gains and a longer feeding period. Corn-fed steers graded choice after 101 days in the drylot—oat-fed steers after 150 days.

Total feed cost for the corn-fed steers was $53.31 a head, compared with $57.18 for the oat-fed steers. Feed cost per 100 pounds of gain, however, was in favor of the oat-fed animals at $23.53, compared with $24.80 for those fed corn.☆

food and home

HOW HOME-CURED HAM KEEPS

■ HOME-CURED HAM is as delicious as it is nourishing—but how does it keep? Let's take a look at some research the Eastern Regional Research Laboratory at Wyndmoor, Pa., is doing on this question.

Dry curing without pumping (injecting a preservative solution) is used by three-fourths of the farmers who cure meat. About half this group use only salt as a curing agent.

For experiments with unpumped, dry-salt-cured ham, scientists used 108 hams from hogs of known history and all fed alike. Hams were salt cured, smoked, and then divided into lots for storage at 40°, 70°, and 90° F. with relative humidities of 90, 75, and 55 percent respectively. Samples were analyzed after 6 weeks, 6 months, and 12 months. Data were obtained on weight losses, chemical constituents, nitrogen efficiency values, vitamin content, palatability, and bacterial flora.

The results showed an average weight loss of 11.5 percent during processing. Appreciable weight losses also occurred during storage, depending on time, temperature, and relative humidity. Loss of moisture due to temperature and humidity differences occurred more slowly in hams stored at 40° F. than at 70° or 90°.

Content of protein, fat, ash, and sodium chloride increased to the degree that hams became dehydrated during storage. Appreciable increases in amounts of soluble nitrogenous compounds occurred only in a sample stored at 90° F. for 12 months; some protein breakdown presumably occurred. There was substantial fat breakdown in hams stored for a period of 12 months at 70° and 90° F. Processing and storage had no detrimental effects on nitrogen efficiency value.

Although no deterioration of riboflavin and niacin occurred during processing and storage, a reduction in thiamine content was observed.

Hams stored at 40° F. aged slightly in 12 months; those stored at 70° deteriorated appreciably in 6 months; and hams held at 90° scored undesirable after 6 months' storage.

Dry-salt-cured farm hams were found wholesome from the standpoint of both numbers and types of bacteria. There was no apparent correlation between bacterial counts and storage conditions, which suggests that bacterial contamination isn't the decisive factor in storage life.

Work is now in progress on other methods of farm curing meat.☆

poultry

TRACERS TELL ON THE CHICKEN

■ ATOMIC ENERGY is helping to reveal basic biological processes by which poultry hatchability, growth, feed efficiency, and egg production may be improved. USDA poultry nutritionists at Beltsville, Md., are seeking these improvements by radioactivation of some diet compounds.

The tracers show the course of these materials through tissues of eggs or chickens, as well as changes in metabolism not readily measured by other means. Also, the method permits use of test materials in minute quantities, thus precluding possible upset of normal physiological activities in eggs or chickens.

Tracer studies have shown that sulfate sulfur (present in many feed ingredients) is of definite value to chickens—not merely an excretory product as long believed. Subsequent feeding trials show sulfate can partly replace the amino acids cystine and methionine, often deficient in diets of farm animals and man.

Biochemical transformations within the egg have been studied by this means. Included are conversion of methionine to cystine and some of it to taurine (a substance found in animal tissue) or sulfate. The sulfate produced is believed necessary for the formation of cartilage.

Methionine thus traced may help develop a new way to estimate amino-acid (protein) requirements of layers. Scientists found more rapid deposit of radioactive sulfur from methionine in hens on a low-protein diet than in those on a normal diet.

Tracer studies also showed that chickens up to 6 weeks old depend largely on the egg supply of growth-promoting vitamin B_{12}. Later, they manufacture a part of their requirements of this important vitamin.

ARS poultry scientist L. J. Machlin has received the Poultry Science Association's annual research award for work in these fields.☆

dairy

DETAILED RECORDS covering the individual histories of more than 3½ million DHIA cows are maintained in files like these by ARS Dairy Husbandry Research Branch. Cow's full record—breed, number, sire, dam, milk and butterfat production, owner, and State—are designated by punches in a card.

DHIA records for the nation

ORGANIZED TESTING AND RECORDKEEPING ARE IMPROVING OUR DAIRY HERDS

FIFTY years ago, high-producing dairy cows were the exception, even in a well-managed herd. Today high-producers predominate in every good herd.

It all began in 1906 when Helmer Rabild, then an inspector for the Michigan Dairy and Food Department, convinced a group of dairymen they should undertake a program of continuous testing and recordkeeping. This plan, Rabild told the Michigan dairymen, was helping improve dairy herds in his native Denmark.

The Dairy Herd Improvement Association program now operates nationwide and in Alaska, Hawaii, and Puerto Rico. According to J. F. Kendrick, USDA head of the program, it is essentially the same as the plan that Helmer Rabild first suggested back in 1906.

Dairymen organize, maintain, and control their own association. They hire and pay a supervisor who tests all cows in each herd every month and maintains records. The testing is done under basic rules established by the

American Dairy Science Association. These are simple, requiring merely that weighing, sampling, and testing be done by the supervisor; that all cows of milking age in the herd be on test; that all cows on test be included in the yearly herd average; and that the information obtained by the supervisor on testing day be used for computing the monthly production of each cow.

At the end of the year, a 12-month record for each cow and each herd is computed from the records maintained in each owner's herd book. This book is used by the owner as a guide in the management of his cows.

Work in each State is under immediate direction of county agricultural agents supervised by the State extension dairyman. Yearly records are sent to Washington for analysis and filing by the ARS Dairy Husbandry Research Branch, which furnishes the record forms.

Helmer Rabild was right when he said testing and recordkeeping would help dairymen improve their herds. These records have made possible intelligent application of three fundamental practices: (1) Culling unprofitable cows, (2) feeding the remaining cows according to their production, and (3) selecting the best breeding stock.

Results of the program are almost unbelievable. Thirty-one herds—239 cows—were tested in the first association organized in 1906. They produced an average of 5,300 pounds of milk and 215 pounds of butterfat, compared with 3,646 pounds of milk and 146 pounds of butterfat for all cows milked in this country during that year.

In 1954, the latest year for which full records are available, there were 2,175 Dairy Herd Improvement Associations, representing 41,254 herds and more than 1,300,000 dairy cattle. These DHIA cows averaged 9,363 pounds of milk and 372 pounds of butterfat, compared with an average for all cows in the nation of 5,447 pounds of milk and 213 pounds of butterfat.

And that's not all. In 1926, the first year in which records of all the associations were averaged on a nationwide basis, 22 percent of the DHIA cows produced less than 225 pounds of butterfat annually. Only 6 percent of the cows produced more than 425 pounds of butterfat, and the over-all average ran 289 pounds.

In 1953 only 7 percent of the DHIA cows produced less than 225 pounds of butterfat, and more than 24 percent of them exceeded 425 pounds. The average was 368 pounds, or about 67 percent more than the average production of all cows milked in the United States.

Last August, the 50,000th herd sire was proved through analysis of DHIA records. This is a phase of the DHIA program begun in 1935 to find production-proved sires and families as sources of breeding stock. The records kept show the influence of different sires on a herd—up or down the scale. A "proved" sire may be a good one or a poor one, of course, depending on the records of his unselected daughters compared with the records of their respective dams. In 1954, a total of 51,912 sires were proved, largest number in one year since the program began.☆

1. First step in gigantic task of recordkeeping is to punch a record card for every cow reported in every herd by 2,100 DHIA field supervisors in the United States, Alaska, Hawaii, and Puerto Rico.

2. Punch marks actuate machines that either sort cards or compile information they carry. This machine sorts by such factors as herds, associations, production, feed costs, income over feed costs.

3. Sorted cards are run through this electronic calculator. It's a mechanical brain that adds, subtracts, multiplies, and divides. In just a few minutes, this machine can compile the data on hundreds of cards in any group—information that is needed for herd and sire performance records reported to agricultural workers and DHIA members. Members can thus compare their herds and sires with others.

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agrisearch notes

BRINE SHRIMP have become guinea pigs for USDA insect pathologists. These tiny crustaceans—barely one-eighth inch long—are being used to detect insecticide residues.

They are sensitive to many insecticides, even in solutions containing as little as 1 part to 100 million.

Pathologists first used the shrimp in bioassay tests to find whether insecticide residues were responsible for unexpected mortality in honey bees—an increasing problem in farm areas.

Available as eggs for tropical-fish food, the shrimp hatch in 24 hours, are ready for test use in 72 hours.

Brine shrimp react to insecticides by changes in normal swimming habits. The rapidity of these changes indicates the concentration of the toxicants.

GRANULAR-TYPE INSECTICIDES—which leave much smaller residues on crops than the accumulations often left by emulsion sprays—hold promise for European corn borer control.

Cooperative research by scientists of USDA and the Iowa experiment station has been conducted for the last 2 years at the European Corn Borer Research Laboratory, Ankeny, Iowa. This work indicates that DDT, EPN, and Heptachlor in granular form give as good or possibly better borer control than these same chemicals as emulsion sprays.

Some tests have shown that the residue left from insecticides applied in granular form ranges from 100 to 200 times less than the residue left from emulsion sprays. Granular insecticides do not cling to leaf surfaces but slide down into the leaf whorls and into the junctions of leaves and stalks, where young corn borers usually feed.

Spray emulsions often leave toxic residues on leaves and stalks of corn. These residues may accumulate in the body fat of livestock or the milk of dairy cows that graze on the corn or eat the silage.

In tests of the effectiveness of granular insecticides, a clay material called attapulgite proved a better carrier or base than tobacco. Researchers found little variation in effectiveness of the three insecticides tried on first-brood borers in the 1953 experiments.

Experiments in 1954 included malathion, which was comparable to the other chemicals on first-brood borers. On second-brood borers, all the toxicants except malathion gave good results. Effective dosages were 1½ pounds of DDT or Heptachlor, or ½ pound of EPN, per acre.

SUPERIOR FLAME-RESISTANT treatment for cotton has been developed by scientists at USDA's Southern Regional Research Laboratory, New Orleans.

Fabrics so treated have passed the most rigid laboratory tests. The treatment combines two previously announced processes—together, they're more effective than either used alone. Insoluble polymers protect the cotton fibers inside and out.

The process comprises a one-bath treatment with a mixture of 1 part BAP (bromoformallyl-phosphate) and 2 parts THPC (tetrakis phosphonium chloride). After impregnation, the cloth is dried and heat-cured. Weight is increased by about 18 percent, but the flame-resistant finish is highly durable in laundering and dry-cleaning.

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